

# Out of the Box

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**Reporting Category** Measurement

**Topic** Applying formulas to measure attributes of shapes

## Materials

- Scissors
- Inch rulers
- Cardboard boxes (e.g., cereal, cracker/cookie, fruit snacks, cake mix, sugar)
- Unit squares
- Markers
- Out of the Box graphic organizer (attached)

## Vocabulary

*perimeter of rectangular figure, area of rectangular figure, volume of rectangular prism* (earlier grades)

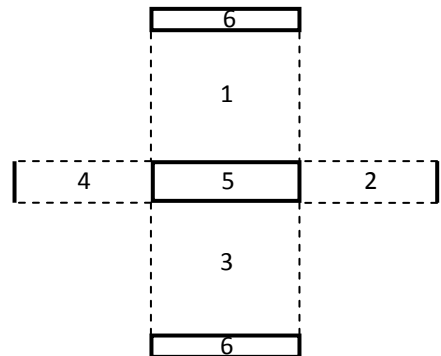
*surface area* (6.10)

## Student/Teacher Actions (what students and teachers should be doing to facilitate learning)

SOL 5.8 introduces students to finding perimeter, area, and volume in standard units of measure. SOL 6.10c and d include application of the same formulas to practical problems and expands to involve the volume and surface area of a rectangular prism.

Ask students to bring in empty cardboard boxes prior to undertaking this activity. Have some extra boxes on hand, also. The various box sizes will provide a deeper understanding of the definitions of *volume* and *surface area*.

1. Distribute scissors, rulers, and cardboard boxes, and point out that every box is a *rectangular prism*. Have each student cut along the four vertical edges of his/her box, leaving the bottom of the box and the top flaps intact. The dotted lines in the figure to the right illustrate where the box should be cut, while the solid lines show creases or edges that should *not* be cut. Have students label the resulting six rectangles or sides with numbers 1 through 6. The top flaps are considered to be *one* rectangle or side that is the same size as the bottom of the box.



2. Distribute copies of the Out of the Box graphic organizer. Have students use the inch rulers to measure the length and width of each box side and record the measurements in the appropriate columns of the first chart on their graphic organizers.
3. Have students multiply the length and width of each box side and record the products in the “Product” column. Ask students about the units (inches), and explain why they become square units (square inches) for the **area of rectangles**.
4. Have students add all of the areas together, which is the total **surface area** of the box. Have them record this value in the appropriate space in the chart. Ask students for other ways to determine the sum of all the areas without measuring each side individually. Record their ideas on the board. Guide them to see that there are only three different sized rectangles in the box. Consequently, multiplying the area of each of these rectangles by 2 and adding the three products results in the surface area:  **$SA = 2lw + 2lh + 2wh$** .
5. Instruct students to use the various recorded measurements to associate a numerical measurement with the length, width, and height of the box. Have them list these measurements in the second chart on their graphic organizers.
6. Introduce the formula for the **volume of a rectangular prism**,  **$V = lwh$** , and have students write it in the blank heading space in the second chart. Have them find the volume of the boxes by substituting the known values into the formula and performing the indicated operations.
7. Review the formulas for surface area and volume of rectangular prisms, connecting the formulas to the measurements made in the activity. Substitute the values into the formulas to show the resulting answers are the same as those calculate with ruler measurements.

### Assessment

- **Questions**
  - How many different dimensions are found in a rectangular prism? (3)
  - How are opposite sides of a rectangular prism related?
  - What are the similarities between the volume and surface area of a rectangular prism?
- **Journal/Writing Prompts**
  - Explain how this activity provided a better understanding of surface area and volume.
  - Describe why knowing the surface area and volume measurements of a cereal box is useful or necessary to a cereal company.

### Extensions and Connections (for all students)

- Have students compare the different surface areas and volumes of various boxes to observe, for example, that a tall skinny box may have the same volume as a shorter, wider box.

### Strategies for Differentiation

- Point out to students that the opposite sides of a box have the same dimensions so that they do not make the same measurement twice.

- Have students label the box's edges with  $l$ ,  $w$ , or  $h$  to more fully understand the connection to the formulas.

# Out of the Box

Name \_\_\_\_\_ Date \_\_\_\_\_

Dimensions of the Sides of the Box			
Box Side	Measurement 1 (Length)	Measurement 2 (Width)	Product of Length and Width (Area)
1			
2			
3			
4			
5			
6			
Surface Area:			

Dimensions of the Box			
Length ( $l$ )	Width ( $w$ )	Height ( $h$ )	